

PRELIMINARY DATA SUMMARY

October 1989

U.S. Army Engineer Waterways Experiment Station
Coastal Engineering Research Center
Field Research Facility
Duck, North Carolina

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CERC Field Research Facility
Duck, North Carolina

This report provides a summary of basic oceanographic, meteorological and bottom profile data for the month. The data were obtained as part of the Measurements and Analysis work units at the U.S. Army Engineer Waterways Experiment Station, Coastal Engineering Research Center's Field Research Facility (FRF) in Duck, North Carolina. The FRF staff collected and analyzed these data. These summaries are intended to make the data readily available to all FRF users, and comments on their content and usefulness are invited.

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PART I: INTRODUCTION

The U.S. Army Engineer Waterways Experiment Station, Coastal Engineering Research Center's (CERC's) Field Research Facility (FRF) is located on the Outer Banks of North Carolina, near the village of Duck (Figure 1).

The FRF research program provides a means for obtaining high-quality field data, particularly during storms, in support of the U.S. Army Corps of Engineers' coastal engineering research missions. The research pier is a reinforced concrete structure supported on 0.9-m-diam steel piles spaced 12.2 m apart along the pier's length and 4.6 m apart across the width. The pier deck is 6.1 m wide and extends from behind the duneline to about the 6-m water depth contour at a height of 7.6 m above the National Geodetic Vertical Datum (NGVD). In addition, a main building contains offices, an instrument repair shop, and a data acquisition room.

One of the responsibilities of the FRF research program is the collection, analysis and dissemination of data on local oceanographic and meteorological conditions. Bottom profiles along both sides of the pier and periodic bathymetric surveys are also performed.

This summary is intended to provide basic data as soon as possible after they are obtained. Questions and/or comments concerning the data may be directed to Mr. Michael W. Leffler at (919) 261-3511.

Part II presents the meteorological data; Parts III through VI present oceanographic data; Part VII presents nearshore profiles and bathymetry; and Part VIII, if included, documents special events that occurred at the FRF during the month.

Table 1 is a list of instruments used, their operational status during the month, and the data collection status. Figure 2 identifies the location of the instruments. The water depths at the wave gages and current meters vary and may be determined from information contained in Figure 7. Other installation information is contained in Table 1.

Times given in the report, unless otherwise specified, are referenced to eastern standard time (EST).

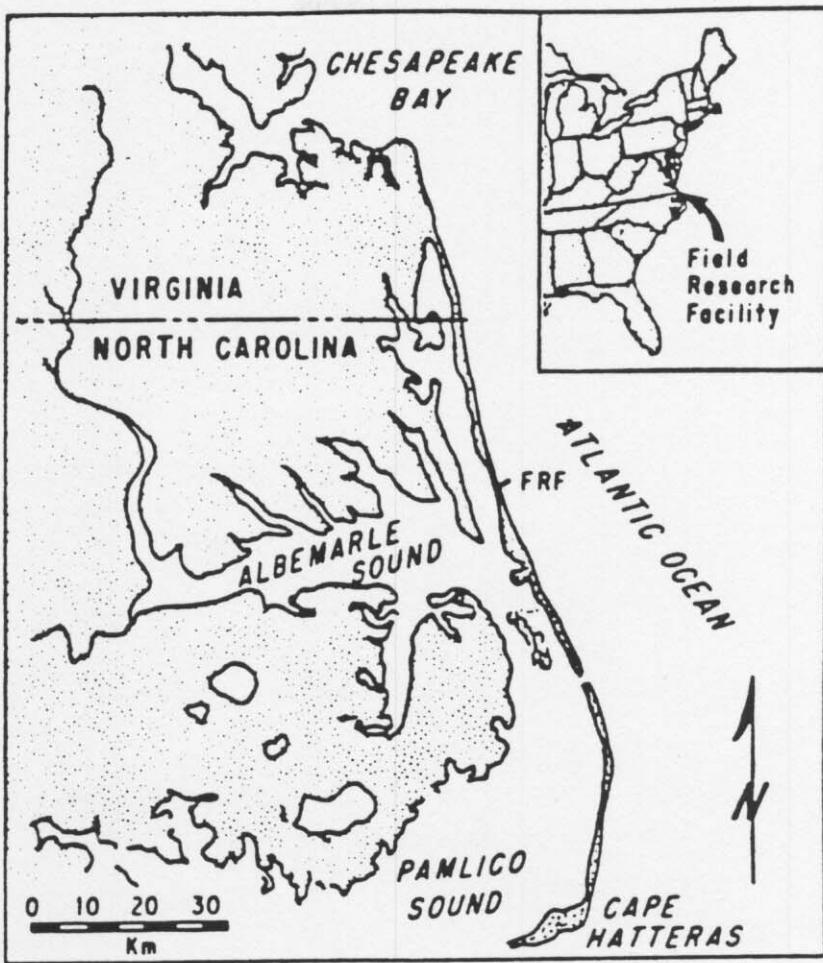


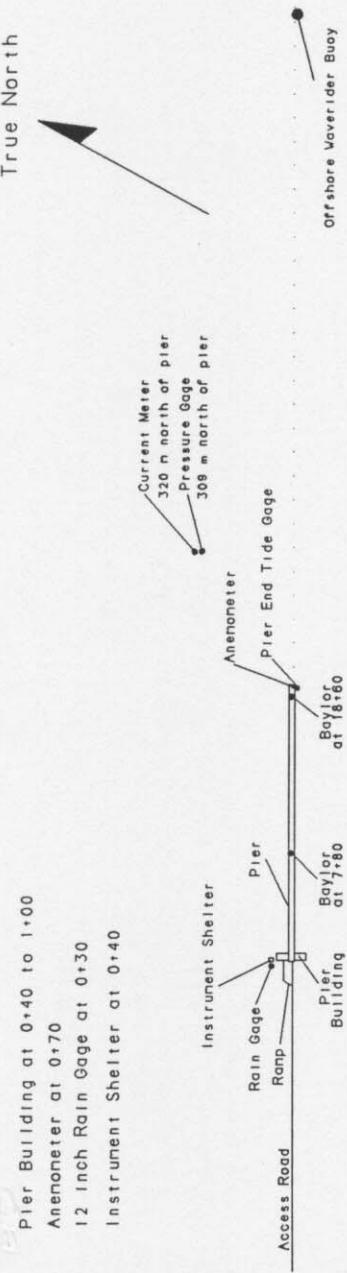
Figure 1. FRF location map

Table 1: Instrument Status/Data Availability

OCT 1989

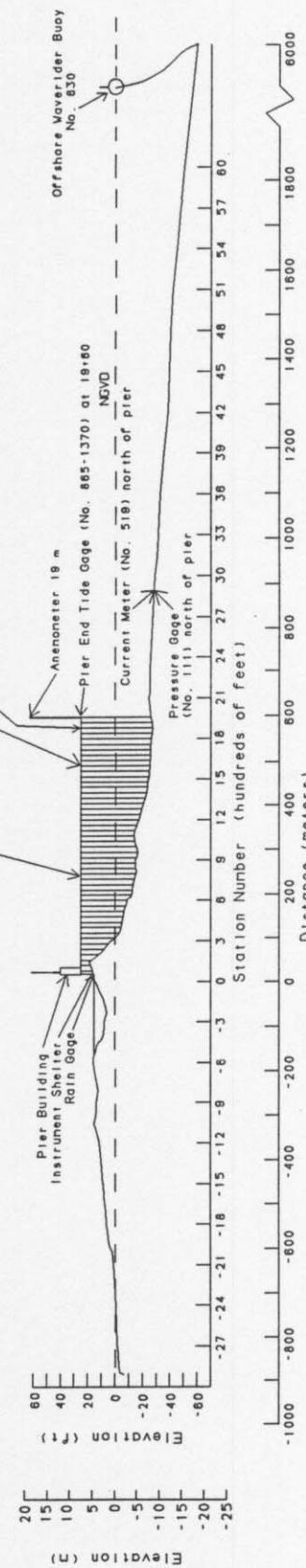
Gage Status	Daily Observation	Analog Record	Data Collected
Operational = *	Complete = *	Complete = *	All = *
Partial = /	Partial = /	Partial = /	Partial = /
Non-Operational = -	None = -	None = -	None = -

True North



CURRITUCK SOUND

ATLANTIC OCEAN



PART II: METEOROLOGICAL DATA

A variety of instruments have been installed at the FRF (Figure 2) to monitor the meteorological conditions. The data presented in Table 2 are collected and stored on magnetic tape using a Digital Equipment Corporation VAX 11/750. For each instrument identified in Table 1 as having analog outputs, chart records are obtained, a log is maintained and the records are stored for future reference.

Winds were measured at the end of the pier at an elevation of 19 m (Figure 2) using a Weather Measure Skyvane anemometer.

Monthly resultant wind speeds and directions are determined by vector averaging the data. Temperature and atmospheric pressure means are the average of the values presented for the month. Total precipitation is the sum for the month.

The following may be useful for converting the data in Table 2 to other frequently used units of measurement:

1. Millimeters (mm) to inches (in.) -
 $mm \times .03937 = in.$
2. Millibars (mb) to inches of mercury (in. Hg) -
 $mb \times 0.02953 = in. Hg$
3. Degrees Celsius (C) to degrees Fahrenheit (F) -
 $(C \times 9/5) + 32 = F$
4. Meters per second (m/s) to knots (kn) -
 $m/s \times 1.943 = kn$

Table 2: Meteorological Data

Oct 1989

Day	Hour	* Wind Speed m/sec	* Wind Direction deg TN	Temperature deg C	Atm Pressure mb	Precipitation ** mm
1	100	4	80	Gage Inoperative	1019.6	0
	700	4	81		1018.6	25
	1300	6	98		1017.5	0
	1900	8	180		1015.9	0
2	100	7	180	Inoperative	1013.5	17
	700	7	173		1011.4	0
	1300	5	119		1008.7	6
	1900	3	60		1008.1	3
3	100	6	180	20.3	1007.4	0
	700	6	180	20.7	1010.1	0
	1300	8	147	24.3	1010.1	0
	1900	2	324	21.5	1010.4	0
4	100	13	351	19.3	1012.5	0
	700	9	3	15.9	1015.5	0
	1300	6	25	18.5	1013.5	0
	1900	4	304	17.0	1013.8	0
5	100	5	307	14.9	1014.2	0
	700	8	1	15.8	1016.2	0
	1300	2	275	18.9	1015.5	0
	1900	4	232	17.4	1014.8	0
6	100	5	214	17.2	1013.5	0
	700	10	233	18.3	1012.8	0
	1300	8	259	24.5	1010.4	0
	1900	5	213	22.2	1009.8	0
7	100	7	236	21.7	1008.4	0
	700	6	287	21.3	1009.4	0
	1300	8	360	19.2	1012.1	0
	1900	6	34	17.8	1013.5	0
8	100	7	41	16.8	1013.1	0
	700	8	42	15.1	1012.1	0
	1300	7	37	14.6	1008.7	0
	1900	7	321	12.9	1010.8	0
9	100	8	317	10.7	1013.5	0
	700	8	314	9.5	1017.5	0
	1300	6	356	14.3	1019.2	0
	1900	4	21	12.8	1020.9	0
10	100	2	263	11.1	1021.6	0
	700	5	76	14.3	1021.6	0
	1300	6	93	18.0	1019.2	0
	1900	3	153	18.1	1016.2	0
11	100	4	316	14.1	1015.9	0
	700	5	318	14.3	1018.2	0
	1300	6	10	20.0	1018.6	0
	1900	4	90	17.6	1020.3	0
12	100	2	94	13.2	1020.9	0
	700	3	117	16.2	1021.6	0
	1300	3	114	21.3	1020.3	0
	1900	5	358	17.7	1019.2	0
13	100	4	227	17.1	1018.9	0
	700	4	246	17.9	1019.2	0
	1300	5	251	22.8	1017.9	0
	1900	2	275	19.4	1017.9	0
14	100	2	219	18.5	1017.5	0
	700	1	214	18.3	1018.2	0
	1300	1	100	21.5	1017.2	0
	1900	2	137	19.4	1016.9	0
15	100	1	216	18.7	1016.2	0
	700	3	239	18.9	1016.9	0
	1300	4	116	24.2	1016.5	0
	1900	4	153	20.4	1016.9	0
16	100	3	160	19.6	1017.5	0
	700	3	218	20.3	1018.9	0
	1300	5	347	26.8	1017.5	0
	1900	7	55	22.0	1016.9	0

(Continued)

Table 2: Meteorological Data

Oct 1989

Day	Hour	* Wind Speed m/sec	* Wind Direction deg TN	Temperature deg C	Atm Pressure mb	Precipitation ** mm
		100	5	219	20.4	0
17	700	5	20	21.2	1016.2	0
	1300	7	259	26.2	1013.5	0
	1900	8	75	23.1	1013.1	0
	100	6	224	22.8	1013.1	0
18	700	4	227	21.8	1012.8	7
	1300	3	156	21.5	1011.4	0
	1900	8	49	19.4	1011.8	0
	100	5	110	19.9	1008.7	0
19	700	8	143	21.0	1008.4	0
	1300	5	220	26.4	1008.4	0
	1900	4	351	20.7	1010.1	0
	100	5	99	20.9	1008.7	0
20	700	12	259	14.4	1008.4	0
	1300	7	262	11.5	1009.4	0
	1900	7	275	12.7	1010.8	0
	100	9	276	9.3	1014.2	0
21	700	8	270	7.9	1016.2	0
	1300	9	220	13.8	1014.2	0
	1900	9	219	13.7	1014.2	0
	100	10	251	14.0	1015.5	0
22	700	8	308	12.2	1018.6	0
	1300	8	360	15.4	1021.3	0
	1900	5	328	13.7	1023.6	0
	100	4	317	11.4	1025.3	0
23	700	10	20	16.5	1026.3	0
	1300	6	21	16.8	1026.7	0
	1900	6	41	15.3	1027.0	0
	100	6	54	15.8	1026.3	0
24	700	10	32	16.1	1026.0	0
	1300	10	25	17.6	1025.0	0
	1900	11	23	16.5	1024.3	0
	100	12	25	16.3	1023.0	0
25	700	11	28	16.1	1023.3	0
	1300	9	12	17.6	1023.3	0
	1900	8	13	16.7	1023.0	0
	100	9	25	16.8	1022.3	0
26	700	8	38	16.9	1023.3	0
	1300	7	17	18.7	1024.0	0
	1900	5	23	16.8	1023.6	0
	100	5	21	16.8	1023.6	0
27	700	6	341	14.3	1024.3	0
	1300	7	1	19.2	1023.3	0
	1900	6	35	17.0	1023.0	0
	100	5	15	16.3	1022.3	0
28	700	5	14	16.7	1022.3	0
	1300	6	19	18.8	1021.3	0
	1900	6	42	17.6	1021.6	0
	100	6	44	17.4	1020.9	0
29	700	7	37	17.8	1021.6	0
	1300	7	50	19.5	1020.6	0
	1900	8	56	18.2	1020.3	0
	100	8	52	17.9	1019.2	0
30	700	6	42	18.0	1019.2	0
	1300	6	37	19.0	1017.5	0
	1900	7	72	19.0	1015.9	0
	100	5	71	18.4	1013.1	6
31	700	6	54	18.4	1009.1	0
	1300	5	255	20.9	1007.4	0
	1900	6	255	19.4	1009.8	0
		Resultant 2	Mean 10	Mean 17.7	Total 1016.7	Total 64

(Sheet 2 of 2)

* Anemometer at end of pier used (gage No. 932)

** Precipitation amounts for 1 & 2 October obtained from
Supplementary Observations

PART III: WAVE DATA

Wave data are collected from two Baylor staff gages (Gages 625 and 645), a pressure wave gage (Gage 111) and a Waverider buoy (Gage 630) as shown in Table 1 and Figure 2. The data are collected, analyzed, and stored on magnetic tape using a Digital Equipment Corporation VAX 11/750 programmed to sample the wave gages every 6 hr (more frequently during storms) beginning at 0100, 0700, 1300, and 1900 EST. The sampling rate is two times per second for four contiguous 34-min records.

Wave height H_{mo} is an energy-based statistic equal to four times the standard deviation of the sea surface elevations. Wave height reported from the pressure gage has been compensated for hydrodynamic attenuation using linear wave theory. Wave period is identified from the computation of a variance (energy) spectrum with 60 deg of freedom calculated from a 34-min record. Peak wave period T_p is defined as the period associated with the maximum energy in the spectrum. When this analysis is complete, the data are written to magnetic tape.

Table 3 presents the wave heights and periods for each wave record obtained at 6 hr intervals during the month. The monthly means and standard deviations from the means shown in Table 3 are average values computed from this data. Figure 3 is a time history of all H_{mo} and T_p values obtained for all gages.

Differences in wave periods between wave gages (Table 3 and Figure 3) may be the result of wave breaking, wave reformation, or the presence of multiple wave trains containing nearly equal energy.

Table 3: Wave Data

Oct 1989

Day	Hour	645		625		111		630	
		Baylor at 7+80	Hmo,m T,sec	Baylor at 18+60	Hmo,m T,sec	Pressure Gage	Hmo,m T,sec	Offshrd Wvrdr	Hmo,m T,sec
1	0100	0.34	4.57	0.53	10.67	0.58	8.00		
	0700	0.53	5.33	0.65	10.67	0.70	5.45	1.02	5.22
	1300	0.52	4.83	0.70	9.85	0.68	6.74	1.08	6.40
	1900	0.64	3.82	0.95	6.24	0.94	6.24	*	
2	0100	0.56	5.45	0.88	7.31	0.93	9.48	*	
	0700	0.68	5.33	1.01	8.83	1.02	5.69	1.49	5.69
	1300	0.53	6.09	0.86	6.92	0.96	6.24	1.31	5.95
	1900	0.53	6.92	0.86	7.76	1.05	8.26	*	
3	0100	0.46	8.00	0.82	8.00	0.99	8.00		
	0700	0.52	7.11	0.96	7.76	0.99	7.76	1.20	7.53
	1300	0.58	3.56	0.91	8.26	0.97	8.26	1.27	7.76
	1900	0.37	8.26	0.68	8.26	0.76	8.26	*	
4	0100	1.04	4.57	1.21	4.57	1.28	4.41	*	
	0700	1.31	6.92	1.62	6.92	1.74	6.92	2.37	6.92
	1300	0.97	6.56	1.17	5.33	1.18	7.53	1.75	7.11
	1900	0.85	6.09	0.95	5.69	1.05	7.31	*	
5	0100	0.56	6.56	0.66	6.74	0.73	6.56	*	
	0700	1.01	5.82	1.08	6.56	1.06	5.95	1.77	5.95
	1300	0.61	6.24	0.71	6.24	0.75	6.24	1.14	6.24
	1900	0.27	5.33	0.41	6.56	0.44	6.24	*	
6	0100	0.18	14.22	0.30	9.48	0.30	9.14	*	
	0700	*		0.23	12.80	0.24	14.22	0.63	2.46
	1300	0.10	12.80	0.19	14.22	0.22	14.22	0.56	2.41
	1900	*		0.24	12.19	0.24	12.19	*	
7	0100	0.25	12.80	0.23	14.22	0.24	13.47	*	
	0700	0.20	13.47	0.21	13.47	0.23	11.64	0.48	2.13
	1300	1.00	5.69	0.98	5.69	1.02	5.22	1.46	5.33
	1900	0.70	5.33	0.74	5.69	0.79	5.57	*	
8	0100	0.76	5.33	0.84	4.92	0.79	4.92	*	
	0700	*		0.93	5.45	0.94	5.22	1.40	5.02
	1300	0.66	5.22	0.65	5.57	0.64	4.74	0.99	5.45
	1900	0.89	4.66	0.78	4.66	0.81	4.57	*	
9	0100	*		0.81	5.12	0.85	5.12	*	
	0700	0.95	5.33	0.86	5.69	0.91	5.33	1.62	5.69
	1300	0.91	6.09	0.91	5.95	0.91	5.95	1.37	5.82
	1900	0.66	5.45	0.78	5.82	0.85	6.24	*	
10	0100	0.50	5.95	0.64	5.95	0.64	6.09	*	
	0700	0.35	4.74	0.45	5.12	0.44	6.24	0.75	6.40
	1300	0.38	3.12	0.58	6.24	0.52	6.09	0.93	3.28
	1900	*		0.77	4.92	0.79	4.92	*	
11	0100	0.43	4.66	0.65	5.12	0.65	4.74	*	
	0700	0.43	5.45	0.61	7.11	0.63	8.00	0.91	5.82
	1300	0.35	4.74	0.60	6.56	0.61	6.24	0.86	5.82
	1900	0.30	4.83	0.44	9.48	0.49	10.67	*	
12	0100	0.31	6.74	0.50	7.31	0.52	6.56	*	
	0700	*		0.54	7.11	0.62	6.92	0.85	6.92
	1300	0.30	6.40	0.53	6.74	0.57	6.24	0.79	6.56
	1900	*		0.50	11.13	0.52	8.53	*	
13	0100	0.25	10.67	0.53	10.24	0.60	10.24	*	
	0700	0.26	8.83	0.49	8.26	0.57	8.83	0.63	8.53
	1300	*		0.42	8.26	0.48	8.00	*	
	1900	*		0.37	7.76	0.47	7.76	*	
14	0100	*		0.38	7.76	0.42	7.31	*	
	0700	*		0.36	8.00	0.42	7.76	*	
	1300	*		0.35	9.48	0.40	10.24	*	
	1900	*		0.38	10.67	0.47	10.67	*	
15	0100	*		0.37	9.48	0.44	9.48	*	
	0700	*		0.42	9.14	0.46	9.48	*	
	1300	*		0.38	9.48	0.42	9.14	*	
	1900	*		0.40	8.53	0.43	8.53	*	
16	0100	*		0.32	8.00	0.38	9.85	0.48	8.00
	0700	*		0.35	8.83	0.41	8.83	0.53	6.92
	1300	*		0.32	9.14	0.35	7.11	0.46	7.76
	1900	*		0.33	9.85	0.36	8.83	*	

* Electronic problems

(Continued)

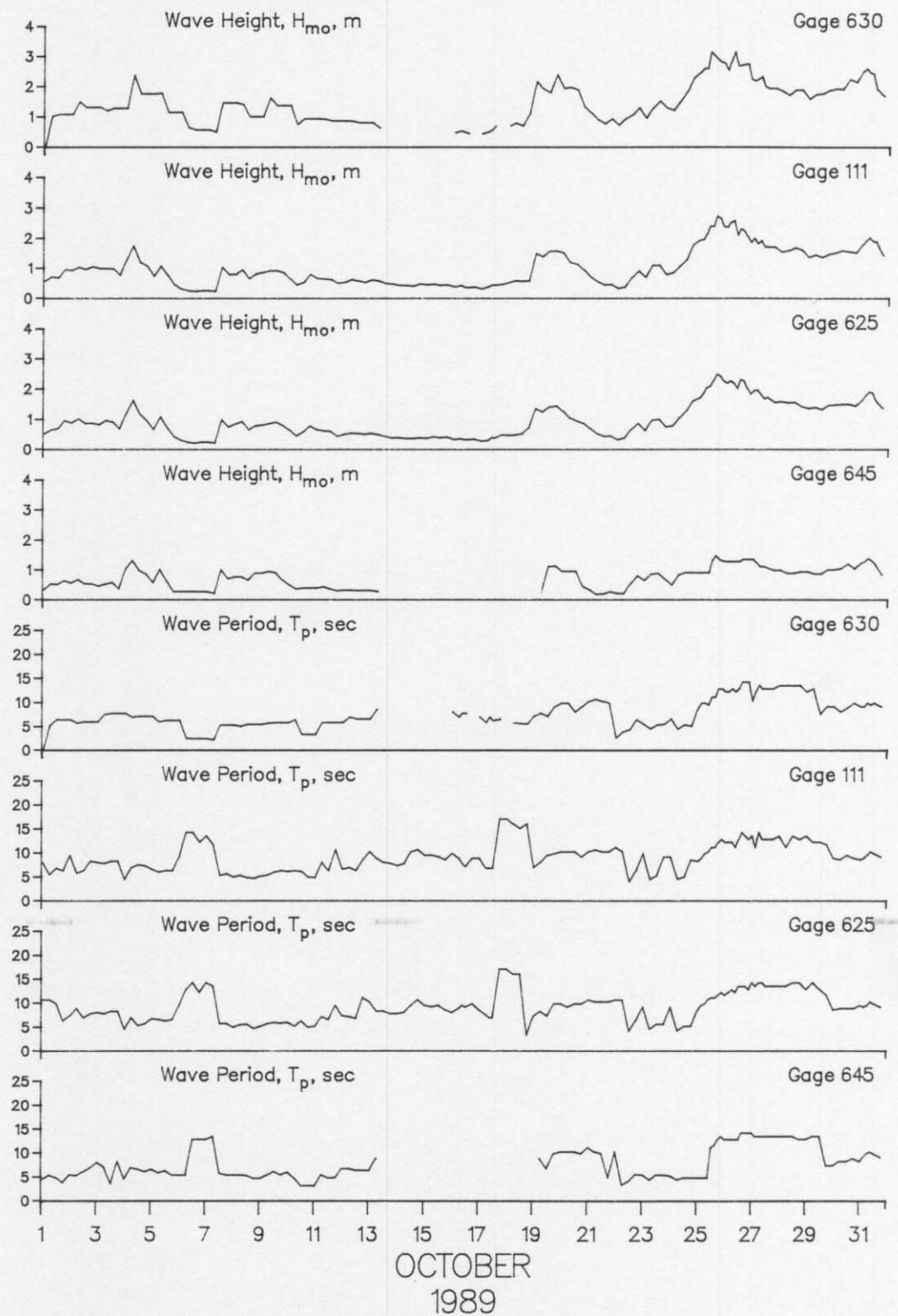
Table 3: Wave Data

Oct 1989

Day	Hour	645		625		111		630	
		Baylor at 7+80	Hmo,m T,sec	Baylor at 18+60	Hmo,m T,sec	Pressure Gage	Hmo,m T,sec	Offshr Wvrdr	Hmo,m T,sec
17	0100	*		0.27	8.53	0.31	8.83	0.45	6.92
	0700	*		0.29	7.53	0.38	6.74	0.51	5.82
	1300	*		*		*		0.69	6.24
	1900	*		0.48	17.07	0.47	17.07	*	
	0100	*		0.47	17.07	0.52	17.07	*	
18	0700	*		0.48	16.00	0.58	16.00	0.78	5.69
	1300	*		0.52	16.00	0.57	15.06	0.69	5.57
	1900	*		0.72	3.28	0.58	16.00	1.10	5.45
	0100	*		1.35	7.31	1.49	6.92	2.15	7.11
19	0700	*		1.25	8.26	1.38	8.00	1.91	7.76
	1300	1.12	6.74	1.41	7.31	1.57	9.48	1.79	7.11
	1900	1.13	9.85	1.45	9.85	1.58	9.85	2.37	9.14
	0100	0.95	10.24	1.28	9.85	1.51	10.24	1.93	9.85
20	0700	*		1.05	9.14	1.19	10.24	1.95	9.85
	1300	0.53	10.24	0.94	9.85	1.12	10.24	1.87	8.00
	1900	0.44	9.85	0.86	9.85	0.93	9.14	1.30	9.14
	0100	0.33	11.13	0.68	10.67	0.69	10.24	1.11	10.24
21	0700	0.18	10.24	0.52	10.24	0.55	10.67	0.89	10.67
	1300	0.19	9.85	0.43	10.24	0.43	10.24	0.76	10.24
	1900	0.27	4.83	0.43	10.24	0.45	10.24	0.93	9.85
	0100	0.21	10.24	0.31	10.67	0.33	11.13	0.72	2.61
22	0700	0.20	3.33	0.38	10.67	0.37	10.24	0.93	3.82
	1300	0.54	4.13	0.67	4.13	0.69	3.94	1.06	4.34
	1900	0.80	5.57	0.86	6.40	0.90	6.24	1.28	6.40
	0100	0.65	5.45	0.63	9.14	0.70	9.85	0.95	5.45
23	0700	0.86	4.41	0.98	4.57	1.09	4.41	1.29	4.49
	1300	0.89	5.45	1.01	5.57	1.09	5.22	1.51	5.33
	1900	0.69	5.45	0.75	5.57	0.79	9.14	1.28	5.45
	0100	0.49	5.22	0.79	9.14	0.84	9.14	1.20	6.56
24	0700	0.83	4.41	1.05	4.20	1.07	4.49	1.51	4.41
	1300	0.91	4.83	1.28	5.12	1.28	4.92	1.82	5.33
	1900	*		1.61	5.22	1.79	8.53	2.29	5.02
	0100	*		1.71	8.53	1.94	8.26	2.47	8.83
25	0700	1.50	11.13	2.04	9.85	2.15	9.85	2.60	9.85
	1300	1.33	11.13	2.29	11.13	2.40	11.13	3.01	11.13
	1900	1.35	12.80	2.43	11.64	2.66	12.19	2.80	12.80
	0100	1.28	12.80	2.20	11.64	2.36	12.19	2.53	12.19
26	0700	*		2.18	12.80	2.58	12.19	3.14	12.80
	1300	1.28	11.64	2.31	13.47	2.30	12.80	2.70	12.80
	1900	*		2.01	13.47	2.04	13.47	*	
	0100	1.14	14.22	1.94	14.22	1.99	13.47	2.18	10.24
27	0700	1.11	13.47	1.81	14.22	1.91	14.22	2.31	13.47
	1300	*		1.71	13.47	1.70	12.80	1.93	12.80
	1900	0.98	13.47	1.56	13.47	1.70	12.80	*	
	0100	*		1.58	13.47	1.54	13.47	1.85	13.47
28	0700	0.88	13.47	1.55	13.47	1.59	11.13	1.71	13.47
	1300	*		1.55	14.22	1.68	13.47	1.88	13.47
	1900	0.93	12.80	1.43	14.22	1.61	12.80	*	
	0100	*		1.36	12.80	1.37	13.47	1.58	12.19
29	0700	0.86	13.47	1.39	14.22	1.44	12.19	1.74	12.80
	1300	*		1.32	12.80	1.36	12.19	1.76	7.53
	1900	1.00	7.31	1.47	11.64	1.47	11.64	1.88	9.14
	0100	*		1.48	8.53	1.52	8.83	1.92	9.14
30	0700	1.05	8.26	1.50	8.83	1.59	8.53	1.91	8.00
	1300	1.20	8.26	1.50	8.83	1.55	9.48	2.24	8.83
	1900	1.04	8.83	1.45	8.83	1.51	8.83	2.14	9.85
	0100	1.23	8.26	1.63	9.48	1.79	8.53	2.51	9.14
31	0700	1.38	9.85	1.91	9.48	2.02	9.48	2.46	9.85
	1300	1.19	9.85	1.62	9.85	1.88	9.85	1.91	9.85
	1900	0.84	9.14	1.38	9.14	1.42	9.14	1.69	9.14
	Mean	0.70	7.70	0.93	9.04	0.99	9.01	1.49	7.73
	Std dev	0.36	3.12	0.54	3.08	0.58	3.00	0.67	2.86

* Electronic problems

(Sheet 2 of 2)



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PART IV: CURRENT DATA

Current data (Table 4) are collected from a Marsh-McBirney electromagnetic biaxial current meter (Table 1 and Figure 2) and by visually observing the movement of dye on the water surface in the surf and at the seaward end of the pier, as well as 500 m updrift of the pier 12 m offshore.

Since the shoreline orientation is approximately N20W, longshore currents flow either toward 340 deg (i.e. northward) or toward 160 deg (i.e. southward). Similarly, cross-shore currents are either onshore (westward) or offshore (eastward).

All current speeds are given in centimeters per second (cm/sec). Resultant speeds and directions are determined by vector averaging the data.

Table 4: Current Data
Oct 1989

Day	Time	Pier Measurements				Beach Measurements			Current Meter	
		Dye at (579 m) (surface)	Distance from Baseline (m)	Speed	Dir	Dye 12m offshore (surface)	Location	Speed	Dir	0.9 km Offshore Depth -5.6m (NGVD) ID #519
1	0100-Along Cross Result									17 S
1	0700-Along Cross Result	11 S 4 off 12 138	128	15 0 15 340	N		South	11 N		10 off 20 130
1	1300-Along Cross Result									17 S 5 off 18 144
1	1900-Along Cross Result									14 S 14 off 20 115
2	0100-Along Cross Result									9 S 8 off 12 118
2	0700-Along Cross Result	36 N 4 off 36 346	128	68 10 68 331	N on		South	22 N		14 S 4 off 15 144
2	1300-Along Cross Result									4 0 4 160
2	1900-Along Cross Result									3 S 4 off 5 107
3	0100-Along Cross Result									1 N 1 on 1 295
3	0700-Along Cross Result	12 S 1 off 12 154	207	14 2 14 331	N on		North	55 N		4 S 8 off 9 97
3	1300-Along Cross Result									6 N 7 off 9 29
3	1900-Along Cross Result									0 8 off 8 70
4	0100-Along Cross Result									1 N 1 off 1 25
4	0700-Along Cross Result	29 S 4 on 29 169	213	38 4 38 166	S on		North	114 S		20 S 12 off 23 129
4	1300-Along Cross Result									21 S 13 off 25 128
4	1900-Along Cross Result									17 S 12 off 21 125
5	0100-Along Cross Result									8 S 8 off 11 115
5	0700-Along Cross Result	38 S 0 160	226	25 5 26 171	S on		North	94 S		16 S 11 off 19 125
5	1300-Along Cross Result									11 S 7 off 13 128
5	1900-Along Cross Result									4 S 1 on 4 174

KEY = All speeds in cm/sec

N = Northward, Shore parallel

S = Southward, Shore parallel

on = onshore off = offshore

Table 4: Current Data (Continued)
Oct 1989

Day	Alongshore Cross-shore Resultant Time	Pier Measurements				Beach Measurements (500m Updrift)			Current Meter	
		Dye at (579 m) (surface)	Distance from Baseline (m)	Speed	Dir	Dye 12m offshore (surface)	Location	Speed	Dir	0.9 km Offshore Depth -5.6m (NGVD) ID #519
6	0100-Along Cross Result								8	N
	Time	Speed	Dir						2	on
									8	326
6	0700-Along Cross Result	23 21 32	N off 22	152	11 12 16	N off 28	South	0	14 13 19	N on 297
6	1300-Along Cross Result								14 6 15	N on 317
6	1900-Along Cross Result								9 5 10	N on 311
7	0100-Along Cross Result								2	S
	Time	Speed	Dir						1	off
									2	133
7	0700-Along Cross Result	47 2 47	S on 163	165	34 3 34	S on 166	North	84 S	1 1 1	S on 205
7	1300-Along Cross Result								17 15 23	S off 119
7	1900-Along Cross Result								6 2 6	N off 358
8	0100-Along Cross Result								0 5 5	off 70
	Time	Speed	Dir							
8	0700-Along Cross Result	17 5 18	S on 177	250	27 3 27	S on 166	North	40 S	16 12 20	S off 123
8	1300-Along Cross Result								10 10 14	S off 115
8	1900-Along Cross Result								16 9 18	S off 131
9	0100-Along Cross Result								21 14 25	S off 126
	Time	Speed	Dir							
9	0700-Along Cross Result	38 0 38	S on 160	240	38 6 39	S off 151	North	89 S	25 12 28	S off 134
9	1300-Along Cross Result								14 14 20	S off 115
9	1900-Along Cross Result								17 10 20	S off 130
10	0100-Along Cross Result								9 10 13	S off 112
	Time	Speed	Dir							
10	0700-Along Cross Result	8 5 9	S off 129	207	6 0 6	S on 160	North	25 S	6 8 10	S off 107
10	1300-Along Cross Result								12 4 13	N on 322
10	1900-Along Cross Result								0 3 3	off 70

KEY = All speeds in cm/sec
 N = Northward, Shore parallel
 S = Southward, Shore parallel
 on = onshore off = offshore

Table 4: Current Data (Continued)
Oct 1989

Day	Time	Pier Measurements				Beach Measurements (500m Updrift)			Current Meter	
		Alongshore Cross-shore Resultant	Dye at (579 m) (surface)	Distance from Baseline (m)	Speed	Dir	Dye 12m offshore (surface)	Location	Speed	Dir
11	0100-Along Cross Result								2	N
11	0700-Along Cross Result	20 2 20	S on 166	226	14 6 15	S off 138		5	S	1 0 2 340
11	1300-Along Cross Result						North			5 off 81
11	1900-Along Cross Result									9 12 15 107
12	0100-Along Cross Result									9 7 11 122
12	0700-Along Cross Result	0 0 0		226	7 1 7	N on 334		51	S	3 3 4 295
12	1300-Along Cross Result						South			
12	1900-Along Cross Result									
13	0100-Along Cross Result									
13	0700-Along Cross Result	15 3 16	N off 351	226	6 7 10	N off 30	North	30	S	
13	1300-Along Cross Result									
13	1900-Along Cross Result									
14	0100-Along Cross Result									
14	0700-Along Cross Result	20 3 21	N off 349	152	4 5 7	N off 30	South	47	S	Gage Inoperative
14	1300-Along Cross Result									
14	1900-Along Cross Result									
15	0100-Along Cross Result									
15	0700-Along Cross Result	27 0 27	N off 340	165	6 3 7	N off 11	South	0		
15	1300-Along Cross Result									
15	1900-Along Cross Result									

KEY = All speeds in cm/sec
N = Northward, Shore parallel
S = Southward, Shore parallel
on = onshore off = offshore

Table 4: Current Data (Continued)
Oct 1989

Day	Time	Pier Measurements			Beach Measurements (500m Updrift)			Current Meter		
		Alongshore Cross-shore Resultant Dye at (579 m) (surface)	Dye at Mid-Surf Zone (surface)	Distance from Baseline (m)	Speed	Dir	Dye 12m offshore (surface)	Location	Speed	Dir
16	0100-Along Cross Result									
16	0700-Along Cross Result	12 5 13	N off 4	— 165	8 2 8	N off 357	South	12	N	
16	1300-Along Cross Result									
16	1900-Along Cross Result									Gage Inoperative
17	0100-Along Cross Result									Gage
17	0700-Along Cross Result	30 8 31	N off 354	— 152	11 3 11	N off 357	South	21	N	
17	1300-Along Cross Result									
17	1900-Along Cross Result									13 8 15
18	0100-Along Cross Result									N on 308
18	0700-Along Cross Result	11 16 20	N off 36	— 165	0 0 0	• South	28	N	10 8 13	N on 302
18	1300-Along Cross Result									7 9 11
18	1900-Along Cross Result									S off 108
19	0100-Along Cross Result									8 16 18
19	0700-Along Cross Result	13 1 13	N off 346	— 347	11 2 11	N on 329	North	126	S	S off 131
19	1300-Along Cross Result									9 31 143
19	1900-Along Cross Result									30 21 37
20	0100-Along Cross Result									S off 124
20	0700-Along Cross Result	11 26 28	S off 92	— 268	0 49 49	off 93	South	98	S	20 1 20
20	1300-Along Cross Result									0 6 6
20	1900-Along Cross Result									2 N off 250
										14 14 14
										62

KEY = All speeds in cm/sec
 N = Northward, Shore parallel
 S = Southward, Shore parallel
 on = onshore off = offshore

Table 4: Current Data (Continued)
Oct 1989

Alongshore Cross-shore Resultant Time Day	Pier Measurements						Beach Measurements			Current Meter		
	Dye at (579 m) (surface)		Dye at Mid-Surf Zone (surface)		(500m Updrift)		Dye 12m offshore (surface)		Location		Speed	Dir
	Speed	Dir	Distance from Baseline (m)	Speed	Dir		Speed	Dir				
21 0100-Along Cross Result										12	N	
										9	on	
										15	303	
21 0700-Along Cross Result	15	N		0					3	N	6	N
	14	off	201	18	off				South	0		
	21	22		18	100					6		340
21 1300-Along Cross Result										16	N	
										11	on	
										19	305	
21 1900-Along Cross Result										23	N	
										12	on	
										26	312	
22 0100-Along Cross Result										14	N	
										11	on	
										18	302	
22 0700-Along Cross Result	32	S		23	S				30	S	7	S
	3	off	207	2	off				North	2		
	32	154		23	154					7	144	
22 1300-Along Cross Result										13	S	
										5	off	
										14	139	
22 1900-Along Cross Result										10	S	
										5	off	
										11	133	
23 0100-Along Cross Result										5	S	
										2	off	
										5	138	
23 0700-Along Cross Result	32	S		51	S				88	S	18	S
	13	on	238	20	on				North	9		
	35	182		55	182					20	133	
23 1300-Along Cross Result										17	S	
										9	off	
										19	132	
23 1900-Along Cross Result										48	S	
										18	off	
										51	139	
24 0100-Along Cross Result										26	S	
										10	off	
										28	139	
24 0700-Along Cross Result	61	S		30	S				60	S	31	S
	9	on	213	6	on				North	14		
	62	169		31	171					34	136	
24 1300-Along Cross Result										25	S	
										11	off	
										27	136	
24 1900-Along Cross Result										32	S	
										17	off	
										36	132	
25 0100-Along Cross Result										34	S	
										17	off	
										38	133	
25 0700-Along Cross Result	38	S		44	S					34	S	
	10	on	226	4	on					17		
	39	174		44	166					38	133	
25 1300-Along Cross Result										23	S	
										14	off	
										27	129	
25 1900-Along Cross Result										25	S	
										20	off	
										32	121	

KEY = All speeds in cm/sec
 N = Northward, Shore parallel
 S = Southward, Shore parallel
 on = onshore off = offshore

Table 4: Current Data (Continued)
Oct 1989

Day	Pier Measurements				Beach Measurements			Current Meter		
	Alongshore Cross-shore Resultant Time	Dye at (579 m) (surface)	Dye at (500m Updrift) Zone (surface)	Distance from Baseline (m)	Speed	Dir	Dye 12m offshore (surface)	Location	Speed	Dir
26 0100-Along Cross Result									5	S
26 0700-Along Cross Result	8 1 8	S off 151		23 14 26	N off 11		55 North	S	13 14	off 91
26 1300-Along Cross Result									24 18 30	S off 123
26 1900-Along Cross Result									12 14 18	S off 111
27 0100-Along Cross Result									19 10 21	S off 132
27 0700-Along Cross Result	10 3 10	N on 326		12 2 12	N off 351		23 South	N	8 2 8	S on 174
27 1300-Along Cross Result									23 6 24	S off 145
27 1900-Along Cross Result									28 16 32	S off 130
28 0100-Along Cross Result									29 22 15	S off 138
28 0700-Along Cross Result	0 0 0			12 7 14	N off 11		25 South	N	27 16 16	S off 126
28 1300-Along Cross Result									14 16 21	S off 111
28 1900-Along Cross Result									11 9 14	S off 121
29 0100-Along Cross Result									12 13 18	S off 113
29 0700-Along Cross Result	20 1 20	S on 163		30 9 32	S off 143		71 South	S	5 11 12	S off 94
29 1300-Along Cross Result									12 10 16	S off 120
29 1900-Along Cross Result									15 12 19	S off 121
30 0100-Along Cross Result									22 16 27	S off 124
30 0700-Along Cross Result	23 9 24	S on 182		10 3 11	N off 357		112 South	N	29 12 31	S off 138
30 1300-Along Cross Result									28 20 34	S off 124
30 1900-Along Cross Result									15 14 21	S off 117

KEY = All speeds in cm/sec

N = Northward, Shore parallel

S = Southward, Shore parallel

on = onshore off = offshore

Table 4: Current Data (Concluded)
Oct 1989

Alongshore Cross-shore Resultant Time Day	Pier Measurements				Beach Measurements (500m Updrift)			Current Meter	
	Dye at (579 m) (surface)	Dye at Zone (surface)	Distance from Baseline (m)	Speed Dir	Dye 12m offshore (surface)	Location	Speed Dir	0.9 km Offshore Depth -5.6m (NGVD) ID #519	
31 0100-Along Cross Result								15 17 23	S off 111
31 0700-Along Cross Result	13 6 14	S on 184	250	38 8 39	N off 351	South	117 N	9 9 13	S off 115
31 1300-Along Cross Result								17 10 20	S off 130
31 1900-Along Cross Result								12 6 13	S off 133

KEY = All speeds in cm/sec
 N = Northward, Shore parallel
 S = Southward, Shore parallel
 on = onshore off = offshore

PART V: SUPPLEMENTAL OBSERVATIONS

Visual wave direction measurements (Table 5) of both the primary wave train (i.e. that having the larger wave heights) and the secondary wave train (which must be clearly distinguishable as a wave train separate from the primary waves but not surface chop or capillary waves) are taken daily at the seaward end of the pier. The direction of the primary wave train just north of the seaward end of the pier is also determined using a Raytheon Marine Pathfinder radar and measuring the alignment of the wave crests at approximately the same location as the visual measurements. The pier axis (considered perpendicular to the beach at the FRF) is orientated 70 deg east of true north; consequently, wave angles greater than 70 deg indicate that the waves were coming from the south side of the pier.

The width of the surf zone (seawardmost breaker position to shoreline) is determined from the pier deck.

Measurements of surface water temperature, density, and visibility are also taken daily at the seaward end of the pier. A jar along with a thermometer is lowered about 0.3 m into the water and allowed to remain for at least one minute. The jar is removed, the temperature read, and a hydrometer is used to determine the density. A Secchi disc is used to determine the surface visibility.

Table 5: Supplemental Observations

Oct 1989

Day	Time	Wave Approach		Radar Wave Angle deg from True N	Width of Surf Zone, m	Water Characteristics at Pier End		
		Primary	Secondary			Temp., C	Density g/cc	Secchi Vis., m
1	0830	80			12	22.2	1.0200	1.2
2	0920	85	130	60	41	22.2	1.0210	1.5
3	0730	90	50	80	69	22.5	1.0212	3.0
4	0700	50		60	115	72.0	1.0214	1.2
5	0730	40		60	31	21.7	1.0194	1.5
6	0800	none visible			35	21.7	1.0208	1.5
7	0815	5			19	21.1	1.0225	1.8
8	1000	45			55	21.1	1.0224	1.5
9	0800	30			47	19.5	1.0204	1.5
10	0800	50			26	19.5	1.0194	2.4
11	0800	90	55		23	19.5	1.0210	3.7
12	0720	110			38	19.5	1.0202	4.0
13	0800	80			49	20.0	1.0219	3.4
14	0830	none visible			16	20.6	1.0220	2.7
15	0800	45	95		13	20.8	1.0218	2.7
16	0800	105			5	21.2	1.0221	3.4
17	0800	110			6	20.6	1.0232	1.5
18	0800	110			9	20.7	1.0234	1.2
19	0800	100	40	90	59	19.9	1.0232	0.6
19	0720	110		50	73	20.6	1.0200	0.3
21	0940	95	50		26	18.9	1.0224	6.7
22	0930	10			21	18.9	1.0230	0.3
23	0750	20			24	18.9	1.0231	0.3
24	0645	50			76	17.8	1.0208	0.9
25	0800	90	35	90	380	18.1	1.0190	0.6
26	0745	95		90	342	17.8	1.0204	0.3
27	0800	90		90	308	17.9	1.0210	0.9
28	0830	90		90	266	18.3	1.0208	0.6
29	0830	50	90	90	247	18.4	1.0190	1.2
30	0830	100		85	271	18.8	1.0184	1.8
31	0745	90		90	306	18.9	1.0182	1.2

PART VI: WATER LEVELS

Since 1978, the National Oceanic and Atmospheric Administration (NOAA)/National Ocean Service (NOS) has operated a primary tide station (No. 865-1370) at the seaward end of the FRF pier. A Leupold-Stevens digital recording float-type tide gage is used to collect instantaneous water level data every 6 minutes throughout the month.

The variation in water level during the month is shown in Figure 4 along with a list of mean and extreme values. This presentation is useful in identifying effects of both meteorological and astronomical forces on the open coast water level.

Table 6 contains the time at the center of each 12.42-hr tidal cycle and the range, high, low, and mean water levels during each tidal cycle.

FRF Tide Heights

Oct 1989

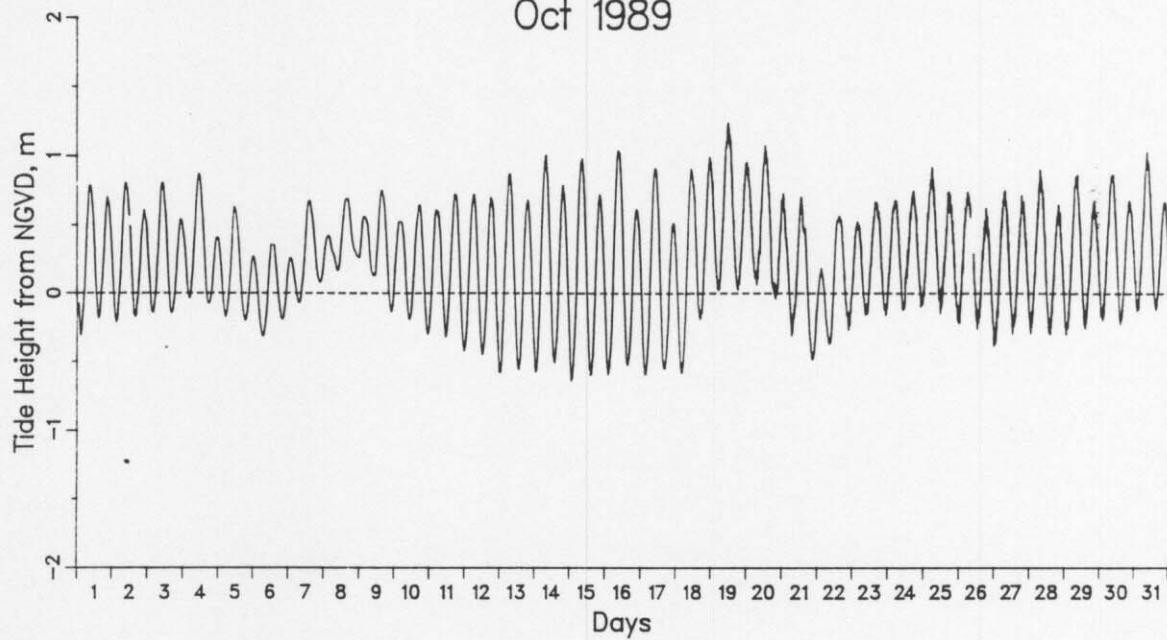


Figure 4. Water Level Time History

Monthly Water Levels, m NGVD

Extreme Low	=	-0.64	on day 15 at	24 EST
Extreme High	=	1.24	on day 19 at	1036 EST
Monthly Mean	=	0.23		
Mean Low	=	-0.27		
Mean High	=	0.73		
Mean Range	=	0.99		

Table 6: Water Levels, m NGVD

		Oct 1989			
Mid-Cycle Day	Time	Low	High	Mean	Range
1	612	-0.31	0.79	0.26	1.09
1	1837	-0.19	0.70	0.24	0.89
2	703	-0.21	0.80	0.31	1.02
2	1928	-0.17	0.61	0.20	0.78
3	753	-0.15	0.81	0.32	0.95
3	2018	-0.15	0.55	0.21	0.69
4	843	-0.04	0.87	0.42	0.91
4	2109	-0.12	0.41	0.14	0.53
5	934	-0.17	0.63	0.23	0.80
5	2159	-0.23	0.27	0.01	0.50
6	1024				
6	2249	-0.19	0.26	0.03	0.45
7	1115	-0.07	0.68	0.32	0.75
7	2340	0.08	0.42	0.26	0.34
8	1205				
9	30	0.24	0.56	0.39	0.32
9	1255				
10	121				
10	1346	-0.20	0.65	0.22	0.84
11	211	-0.30	0.61	0.17	0.91
11	1436	-0.32	0.72	0.21	1.05
12	301	-0.42	0.72	0.15	1.15
12	1527	-0.45	0.70	0.10	1.15
13	352	-0.58	0.87	0.17	1.44
13	1617	-0.55	0.68	0.06	1.23
14	442	-0.57	1.01	0.24	1.58
14	1707	-0.51	0.79	0.10	1.30
15	532	-0.64	0.98	0.21	1.62
15	1758	-0.59	0.72	0.05	1.31
16	623	-0.59	1.04	0.26	1.63
16	1848	-0.52	0.62	0.03	1.14
17	713	-0.59	0.91	0.19	1.50
17	1938	-0.55	0.52	-0.04	1.07
18	804	-0.58	0.91	0.21	1.49
18	2029	-0.19	0.99	0.40	1.18
19	854	0.02	1.24	0.63	1.22
19	2119	0.03	0.95	0.48	0.93
20	944	0.06	1.07	0.54	1.01
20	2210	-0.06	0.73	0.27	0.79
21	1035	-0.31	0.70	0.20	1.01
21	2300	-0.49	0.18	-0.15	0.67
22	1125	-0.37	0.56	0.14	0.94
22	2350	-0.27	0.52	0.15	0.79
23	1216	-0.16	0.66	0.27	0.82
24	41	-0.16	0.68	0.27	0.84
24	1306	-0.12	0.75	0.32	0.87
25	131	-0.10	0.91	0.38	1.01
25	1356	-0.15	0.74	0.31	0.88
26	222				
26	1447	-0.26	0.62	0.16	0.88
27	312	-0.38	0.75	0.20	1.13
27	1537	-0.29	0.71	0.20	1.01
28	402	-0.29	0.90	0.30	1.19
28	1628	-0.30	0.65	0.15	0.94
29	453	-0.30	0.86	0.29	1.16
29	1718	-0.25	0.68	0.21	0.94
30	543	-0.20	0.87	0.36	1.06
30	1808	-0.23	0.68	0.24	0.91
31	634	-0.12	1.03	0.44	1.16
31	1859	-0.12	0.66	0.29	0.78

PART VII: NEARSHORE PROFILES

A. Nearshore Profiles. In order to document profile response away from the pier, surveys of four profile lines extending 900 to 1,000 m from shore and located 489 and 581 m north and 517 and 608 m south of the FRF pier are conducted bi-weekly, after storms, and during more complete bathymetric surveys.

These profiles are obtained using the CRAB-Zeiss surveying system; a Zeiss Elta-2 first-order, self-recording electronic theodolite distance meter in combination with the Coastal Research Amphibious Buggy (CRAB), a 10.7 m high, self-powered, mobile tripod on wheels.

Figure 5 shows the last survey in September and the only survey in October on profile line 188, located 517 m south of the pier. On the foreshore (60 - 120 m) a prominent berm returned while just off shore (120 - 260 m) the nearshore bar migrated 10 m shoreward then moved 40 m seaward. Offshore there was a deepening of the trough (220 - 360 m) as well as a flattening of the offshore bar (360 - 560 m).

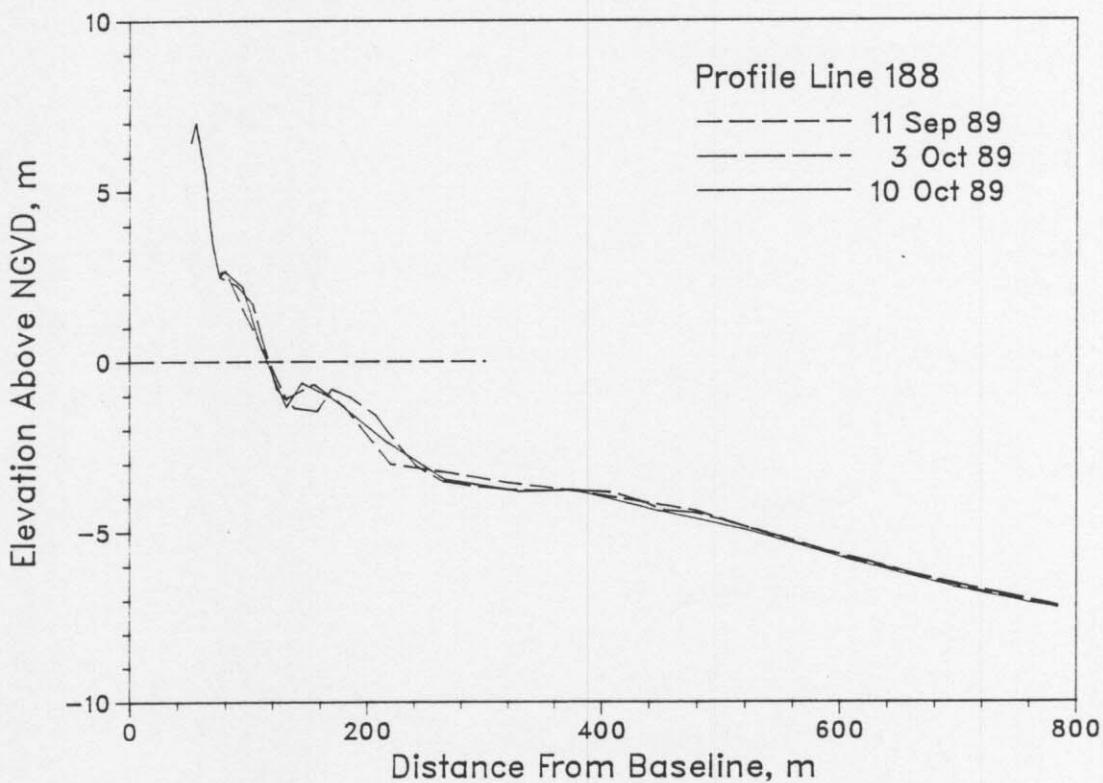


Figure 5. Monthly CRAB profiles on profile 188 - 517 m south of pier.

The profile envelope (Figure 6) reflects the maximum changes that occurred on the profile during 1989. The largest change is a result of the seaward movement of the nearshore bar.

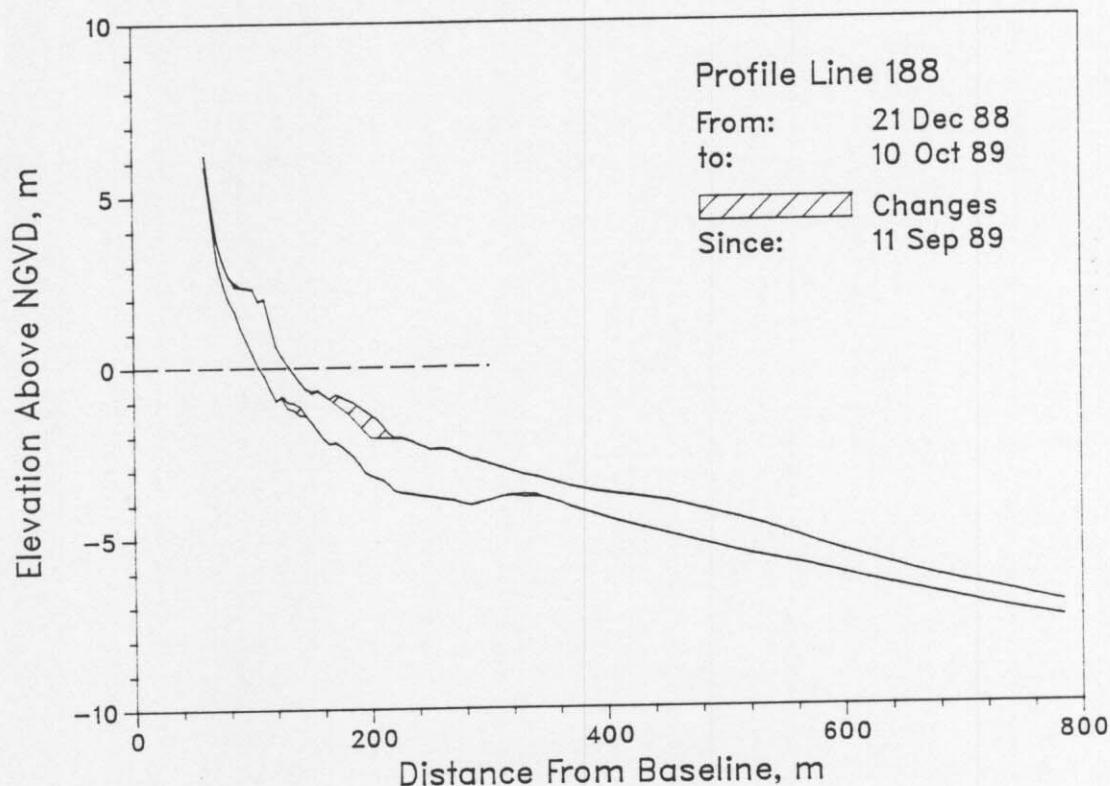


Figure 6. CRAB profile envelope - profile 188.

B. Bathymetry. Figure 7 includes a two- and three-dimensional contour map and a change plot derived from the bathymetric survey on 12 September (there was no survey in October). Wide contour lines on the change diagram represent eroded areas; thin lines indicate deposition.

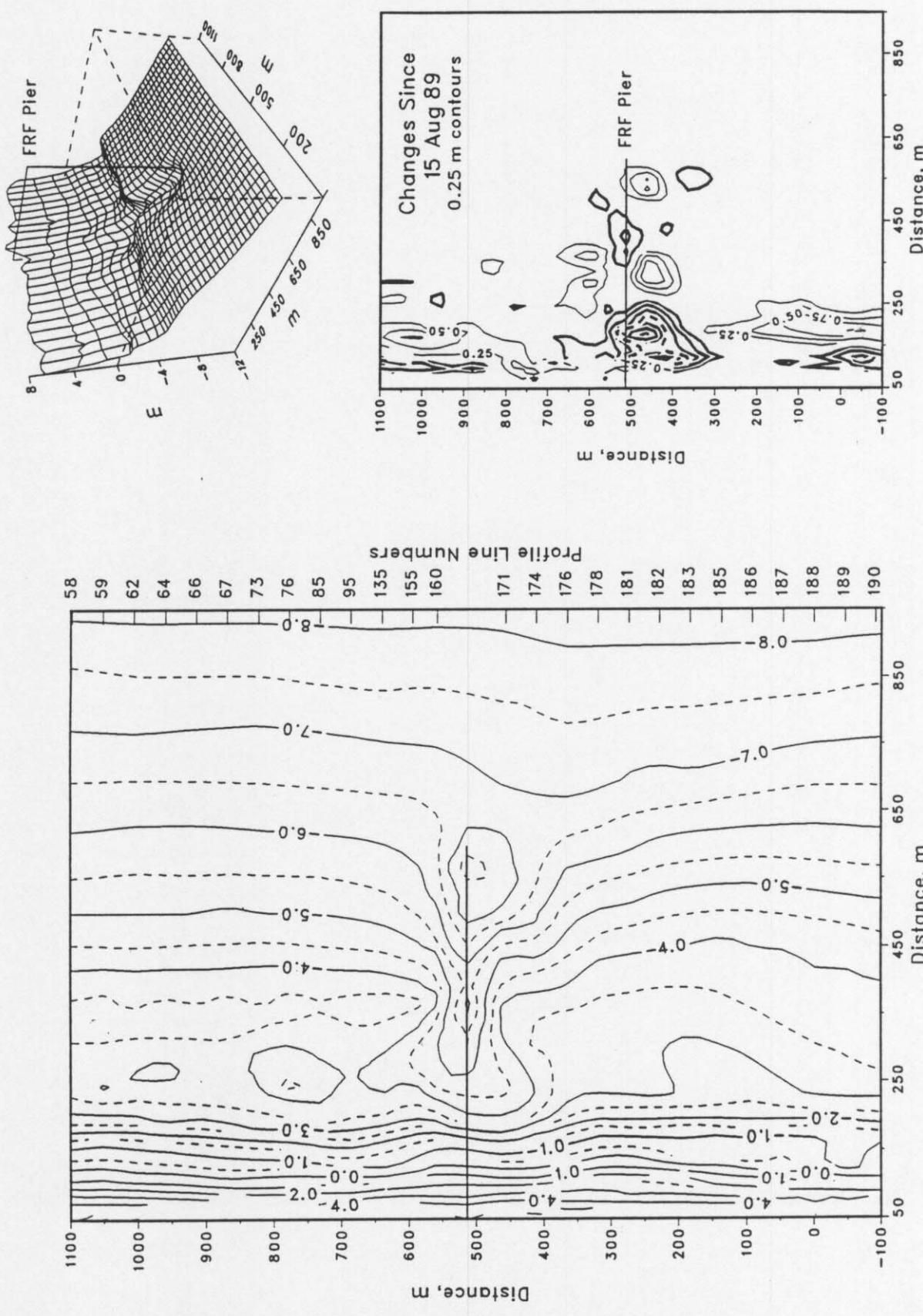


Figure 7. FRF bathymetry 12 Sep 89 depths relative to NGVD

PART VIII. SPECIAL EVENTS

A. Storm Data Collection. The following list identifies times when the significant wave height at the seaward end of the pier (i.e. as measured at the end of the pier) exceeded 2 m and four contiguous 34 minute wave records were obtained every three hours:

<u>Start</u>	<u>End</u>
25 Oct (0700)	26 Oct (1934)

B. Storm Synopsis.

25-26 October - A strong high pressure system stalled over West Virginia generated winds (from north-northeast) which produced storm waves for two days at the FRF. Peak winds of 13 m/s were recorded early on 24 October with the maximum H_{mo} (at gage 625) of 2.60 m ($T_p = 12.19$ sec) occurring at 2008 EST on 25 October.

Distribution List

Government Agencies:

OCE	U.S. Geological Survey
BERH	U.S. National Park Service
NAO	U.S. Naval Academy
NASA/Wallops Flight Center	U.S. Naval Civil Eng. Lab
NOAA (NOS, NWS)	U.S. Naval Fac. Eng. Com.
SAD	U.S. Naval Oceanographic Off.
SAW	U.S. Naval Research Lab

Colleges/Universities:

Allegheny University	Southern Illinois University
California Inst. of Tech.	Stockton State College
East Carolina University	University of Akron
Florida Inst. of Tech.	University of Delaware
Harvard University	University of Florida
Naval Post Graduate School	University of Maryland
NC State University	University of Miami
Old Dominion University	University of North Carolina
Oregon State University	University of N. Colorado
Prince George's College	University of Rhode Island
Rutgers University	University of Virginia
Scripps Inst. of Oceanography	Va. Inst. of Marine Science

Others:

City of Va. Beach, VA	MEC Systems Corporation
Coastal Barge Corporation	Moffatt & Nichol, Eng.
Coastal and Est. Res., Inc.	Offshore Coastal Technologies
Coastal Science & Eng., Inc.	Mr. Rowland
Dr. Galvin	Mr. Savage
GEOMET Tech., Inc.	Sea Port Supply Corp.
Greenhorne & O'Mara, Inc.	Shell Development
Dr. Hylton	Sherwood Industries
Mary Marr, Inc.	Mr. & Mrs. Valpey
Mr. Mason	WCTI-TV
Masonite Corporation	SEASUN Power Systems

Foreign:

W. F. Baird & Asso. Coastal Engineers, Ltd (Canada)
Queen's University, Ontario (Canada)
Ministry of Construction, Coastal Division (Japan)
Norwegian Hydrodynamic Laboratories (Norway)
University of New South Wales (Australia)
University of Sydney (Australia)